

REMARKS

This response is intended as a complete response to the Office Action dated July 3, 2006. In view of the following discussion, the Applicants believe that all claims are in allowable form.

CLAIM OBJECTIONS

Claim 10 stands objected to for containing a typographical error. In response, the Applicants have amended claim 10 to correct the error.

CLAIM REJECTIONS

§102 Claims 1-2, 4, 5, 6 and 12

Claims 1-2, 4, 5, 6 and 12 stand rejected as being anticipated by United States Patent No. 6,281,135 issued August 28, 2001, to *Han, et al.* (hereinafter *Han*). The Applicants respectfully disagree.

Independent claim 1 recites limitations not taught or suggested by *Han*. "Anticipation requires the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim" (Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984) (citing Connell v. Sears, Roebuck & Co., 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)) (emphasis added)). Here, *Han* fails to identify each of the claimed elements as arranged in the independent claims so as to establish a *prima facie* case of anticipation.

Han discloses a method for stripping photoresist and/or removing post etch residue from a semiconductor wafer that is performed "after each etching step." (*Han*, Abstract; col. 6, l. 37.) This method comprises generating a plasma from a gas composition of a hydrogen-bearing gas and a fluorine-bearing gas. (*Id.*, col. 6, ll. 39-45.) The fluorine-bearing gas is one from the group of $C_xH_yF_z$, NF_3 , F_2 , SF_6 , CF_4 , and CHF_3 . (*Id.*, col. 6, l. 66 – col. 7, l. 5.) The hydrogen-bearing gas is a hydrocarbon, hydrofluorocarbon, hydrogen gas or hydrogen gas mixtures. (*Id.*, col. 7, ll. 6 – 24.) A hydrocarbon gas may be partially substituted with a halogen or with oxygen, nitrogen, hydroxyl and amine groups. (*Id.*)

However, *Han* fails to teach or suggest a plasma etch process for selectively etching a layer of low-k dielectric material having a dielectric constant less than 4, comprising introducing into a plasma etch chamber, in which the layer of low-k dielectric material is situated, an etching gas mixture comprising a fluorine-rich fluorocarbon or hydrofluorocarbon gas, a nitrogen-containing gas, and a hydrogen-rich hydrofluorocarbon gas, and maintaining a plasma of the etching gas mixture in the plasma etch chamber to etch the layer of low-k dielectric material, as recited in independent claim 1. Specifically, *Han* fails to teach or suggest etching a layer of low-k dielectric material in the manner recited by the present claims. As discussed above, *Han* merely teaches and suggests stripping photoresist and/or removing post etch residue, after an etching step is performed.

In addition, *Han* specifically fails to teach or suggest an etching gas mixture comprising a fluorine-rich fluorocarbon or hydrofluorocarbon gas, a nitrogen-containing gas, and a hydrogen-rich hydrofluorocarbon gas, as recited in claim 1. *Han* discloses a gas mixture for photoresist stripping and/or post-etch residue removal containing only a fluorine bearing gas and a hydrogen bearing gas. The inclusion of nitrogen in a gas mixture is disclosed as an element in a hydrogen bearing gas, and not as a separate gas in a gas mixture in addition to a hydrogen bearing. To that end, with particular respect to claims 2 and 5, *Han* also fails to disclose or suggest wherein the nitrogen-containing gas is N₂, as recited in claim 2, and wherein the nitrogen-containing gas is selected from the group consisting of N₂, NH₃, NF₃ and mixtures thereof, as recited in claim 5.

Thus, independent claim 1, and claims 2, 4, 5, 6 and 12 depending therefrom, are patentable over *Han*. Accordingly, the Applicants respectfully request that the rejection be withdrawn and the claims allowed.

§103 Claims 9 and 10

Claims 9 and 10 stand rejected under 35 U.S.C. §103 as being unpatentable over *Han* in view of U.S. Patent No. 6,291,357 issued September 18, 2001 to *Zhang, et al.* (hereinafter *Zhang*). The applicants respectfully disagree.

Independent claim 1, from which claims 9 and 10 depend, recites limitations not taught or suggested by the combination of *Han* and *Zhang*. The patentability of claim 1 over *Han* has been discussed above. *Zhang* generally discloses a method for etching a substrate resulting in reduced microloading by applying bias power in stages to a gas in a substrate processing chamber. Specifically, *Zhang* discloses adjusting a bias power level applied to process electrodes in accordance with desired process conditions.

However, *Zhang* fails to teach or suggest an etching gas mixture comprising a fluorine-rich fluorocarbon or hydrofluorocarbon gas, a nitrogen-containing gas, and a hydrogen-rich hydrofluorocarbon gas, and maintaining a plasma of the etching gas mixture in the plasma etch chamber to etch the layer of low-k dielectric material, as recited by independent claim 1. As such, *Zhang* fails to teach or suggest a modification to the teachings of *Han* that would yield the limitations recited in claim 1. Thus, a *prima facie* case of obviousness has not been established because the combination of the cited references fails to yield the limitations recited in the claims.

Thus, claims 9 and 10 are patentable over *Han* in view of *Zhang*. Accordingly, the Applicants respectfully request that the rejection be withdrawn and the claims allowed.

§103 Claim 11

Claim 11 stands rejected under 35 U.S.C. §103 as being unpatentable over *Han* in view of U.S. Patent No. 5,888,414 issued March 30, 1999 to *Collins, et al.* (hereinafter *Collins*). The applicants respectfully disagree.

Independent claim 1, from which claim 11 depends, recites limitations not taught or suggested by the combination of *Han* and *Collins*. The patentability of claim 1 over *Han* has been discussed above. *Collins* generally discloses an apparatus and process for plasma processing using an antenna to generate a high density, low energy plasma for etching oxygen containing layers. Specifically, *Collins* discloses the use of a static, peripheral annular (shallow) magnetic field to reduce losses, *i.e.*, decreased plasma density in the chamber. (*Collins*, col. 18, ll. 18 – 21.)

However, *Collins* fails to teach or suggest an etching gas mixture comprising a fluorine-rich fluorocarbon or hydrofluorocarbon gas, a nitrogen-containing gas, and a

hydrogen-rich hydrofluorocarbon gas, and maintaining a plasma of the etching gas mixture in the plasma etch chamber to etch the layer of low-k dielectric material, and wherein as recited by independent claim 1. As such, *Collins* fails to teach or suggest a modification to the teachings of *Han* that would yield the limitations recited in claim 1. Therefore, a *prima facie* case of obviousness has not been established because the combination of the cited references fails to yield the limitations recited in the claims.

Thus, claim 11 is patentable over *Han* in view of *Collins*. Accordingly, the Applicants respectfully request that the rejection be withdrawn and the claim allowed.

ALLOWABLE SUBJECT MATTER

The Applicants thank the Examiner for her comments regarding the allowability of claims 3, 7-8 and 13, if rewritten in independent form. However, in view of the above discussion, the Applicants respectfully request allowance of these claims as they stand.

CONCLUSION

Thus, the Applicants submit that all claims now pending are in condition for allowance. Accordingly, both reconsideration of this application and its swift passage to issuance are earnestly solicited.

If, however, the Examiner believes that any unresolved issues still exist, it is requested that the Examiner telephone Mr. Alan Taboada at (732) 935-7100 so that appropriate arrangements can be made for resolving such issues as expeditiously as possible.

Respectfully submitted,

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Date

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